

## Supply Chain Vulnerability and Mitigation Strategy of the Manufacturing Firms in Indonesia: Manager's Perspectives

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**Abstract:** Recent supply chain accidents due to epidemics, terrorist attacks and severe earthquake in Haiti killing thousands of people as well as typhoon over Manila causing flood to wash out millions worth of property, indicate that firms are vulnerable in today's highly integrated supply chains. Global financial crisis started in the mid 2007 has also brought further implications on supply chain problems. As economic recession reached the bottom line, supply chain managers experience a different kind of risks as the source of vulnerability. The effectiveness of supply chain mitigation strategy which provide a greater ability to respond volatile circumstances is immediate important. This study explores the perspectives of managers in the manufacturing firms on supply chain vulnerability and mitigation strategy within Indonesian environment. The result reveals that supply chain vulnerability is a relatively new concept for them. However, their firms have implemented certain mitigation actions to avoid fatality in the supply chain network.

**Key words:** Supply chain vulnerability, mitigation strategy, manufacturing sector, Indonesia

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### INTRODUCTION

Supply chain consists of a number of firms across different boundary activities to form a vertical structure as a network. The members of this network depends each others in value chain activities to achieve competitiveness in delivering the product to the customers (Lambert *et al.*, 1998). Supply chain is exposed not only to the risks that come from external environment but also the risks caused by suboptimal interaction between the organisations within the network (Juttner *et al.*, 2003; Gaonkar and Viswanadham, 2006). The extension of supply chain into international context has added the complexity of this network to make it more vulnerable to disruptions (Christopher and Lee, 2004; Bozarth *et al.*, 2009). Business environment that has become so dynamic as well as supply chain development into more efficient structure tend to exacerbate the impact of supply chain risks.

Supply chain as a vertical structure is in fact dynamic networks of interconnected firms and industries with a tendency to focus on common objective (Grabowski and Roberts, 1997; Peck, 2005; Coyle *et al.*, 2008). Relationships between supply chain members are dependence on efficient and reliable structure that link the process from the initial assembly of raw material until the distribution of final product (Christopher, 2002; Nagurney, 2006). The visibility of this structure is beyond the capabilities of individual manager or even single organization to address it (Beers *et al.*, 1999; Cucchiella

and Gastaldi, 2006). Accordingly, it could be concluded that supply chain as a whole is vulnerable not only from external factors but also from internal factors within the network. Whatever, it exceed the managerial reach of a single firm as each firm in the network is a part function of other firms (Simons, 1999; Blackhurst *et al.*, 2005; Zsidisin and Smith, 2005). In supply chain, the management of a single firm and inter-dependence between firms must be in line to achieve not only individual but also mutual goals.

The cost of natural disasters in Indonesia such as Tsunami and earthquake is enormous. The cost generation of Aceh's Tsunami in 2004 reached Rp. 5 trillion while the total loss of earthquake in Indonesia between 2006 and 2009 has reached almost Rp. 6 trillion. Terrorist attacks at JW Marriott and Ritz-Charlton Hotels in July 2009 has increased the uncertainty influencing market risk and business confidence. Under utilized production capacity because of global crisis has become a challenge to maintain business continuity. The implementation vulnerability mitigation strategy in a recession period has raised a new level of importance.

**Environmental impediment:** Indonesia is often referred to as the world's largest archipelago, a name which aptly, represents its 17,508 islands which span eastward from Sabang in northern Sumatera to Merauke in Irian Jaya. Several areas are located in the hinterland surrounding by mountains which are very difficult to reach. This geographic typology raises specific problem for supply

chain resulting complication for the integration of material procurement, manufacturing and product distribution. Manufacturing must be located at strategic location to bridge raw material delivery and product distribution. Firms operated in west side needs to travel >6.300 km to reach the most eastern region. This situation has witnessed the present of local wholesalers as a part of supply chain network in distributing the product to remote area. In an archipelago country, product distribution to the customers poses various barriers due to infrastructure, transportation and geographical difficulty. A long distance to reach the customers and the use of several modes of transportation may raise transaction costs. Congestion problems at the port specifically during big waves and Hari raya are common phenomena. In February 2008, coal supplies to some power plants in Java have been stopped, as ships cannot depart from Sumatra ports because of big waves. This power crunch has caused the blackout in Java and Bali due to an electricity deficit. Infrastructure availability in distributing the materials and products plays an important factor in the supply chain efficiency. Wahyu Tunggono, Head of the Relation Department in Indonesia Supply Chain and Logistics Association stated that Indonesia's main area of weakness in supply chain activities is its infrastructure, especially ports and road. In many occasions such as Hari raya, winnie seasons or dry seasons, the supplies for certain products and commodities could not meet the demand.

The gap in product price could range very widely between regions depends on their accessibility. Inflation in Indonesia is still relatively high compared to other Asean countries, even compared to the Philippines which is also an archipelago country. This means that product distribution and product availability are still a problem in Indonesia islands. Inflation in Indonesia reached 11.7% in 2008 compared to Singapore (4.3%), Malaysia (4.4%), Thailand (0.4%) and the Philippine (8%) (Table 1). High inflation is correlated to higher interest rate to finance business activities that may reduce competitiveness. Supply chain in this wide archipelago country is very vulnerable to transportation disruptions. The change in fuel prices and exchange rate volatility could easily erode the firm competitiveness. Moreover, the volatility of Rupiah is higher compared to other ASEAN's currency at average which made the decision on purchasing time critically important (Fig. 1). Purchasing and warehousing strategies will have essential role in maintaining product price stability and product availability in the market. Indonesia islands are also located within two active mountain belts, the Pacific mountain belt and the Alpid mountain belt (Fig. 2). The pacific mountain belt which

Table 1: Inflation in (Asean)

Countries	2005 (%)	2006 (%)	2007 (%)	2008 (%)
Thailand	5.8	3.5	3.2	0.4
Singapore	0.5	1.0	2.1	4.3
Malaysia	3.5	3.1	2.4	4.4
Philippine	6.7	4.3	3.9	8.0
Indonesia	17.1	6.6	6.6	11.1

Internation financial statistics, 2009

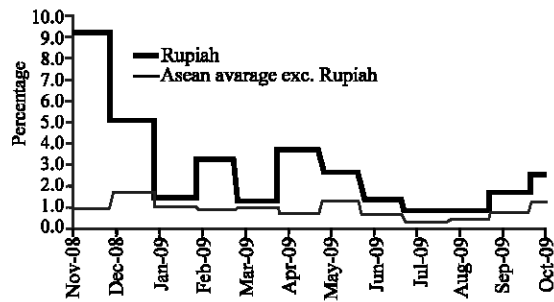


Fig. 1: Rupiah volatility vs Asean average

is called the Pacific ring of fire is the place of 90% of the world's earthquakes and 80% of the world's largest earthquakes. While the second most active seismic belt is the Alpid belt extending from Java to Sumatra through the Himalayas, the Mediterranean and out into the Atlantic, referring to 17% of the world's largest earthquakes. This condition has made Indonesia is often exposed to earthquakes, mount disruptions and some times Tsunami. As a consequence, infrastructure development in Indonesia becomes more expensive to mitigate the risk. Indonesia is affected by three weather systems the Indian Ocean Dipole, the Pacific Ocean system with El Nino and the Asian monsoon. The Indian dipole creates a reversal of the sea-surface temperature gradient and winds along the equatorial region of the Indian Ocean, bringing cooler water to the east (Unger, 2007).

Heavy rains and regular floods in Western Indonesia is the impact of the Indian Ocean dipole. The conjunction of these three systems together has made the weather is unstable and difficult to predict causing riskier sea transportation.

**Problem statement:** There are various problems associated to supply chain vulnerability that need further investigations. Research problems in this study come from unique geographical condition of Indonesia, theoretical gap and unexplored area in supply chain vulnerability concept. These three research problems are inter-connected to generate an urgency need to develop framework that links supply chain vulnerability and mitigation strategy. There are several impediments in the implementation of supply chain activities in Indonesia. Geographical problems include wide-coverage area



Fig. 2: The pacific ring of fire (The world Atlas)

spreading over thousands of islands, location at the conjunction of two active mountain belts and unpredictable weather causing floods and sea transportation disruptions. Economic problems consist of high inflation, volatile exchange rate and infrastructure handy cap that could easily erode competitiveness. In the literature, a more detail and structured approach to conceptualizing supply chain vulnerability could be found only within last decade. Perrow (1999) analyzes the complexity and dependence in the supply chain that allows unexpected risk interaction to defeat the safety of the system. This study highlights the importance of redundancy and safety measures in the supply chain strategy to reduce vulnerability. Nevertheless, the analysis focuses on redundancy strategy without considering supply chain development toward efficiency. Supply chain vulnerability requires further development both in term of the concept, exploratory studies and empirical analysis (Juttner *et al.*, 2003; Peck, 2005; Wagner and Neshat, 2009).

The fuel protest in 2000 followed by foot and mouth disease as well as terrorist attack in 2001 have attracted the recognition on supply chain vulnerability. The impact and scale of disruptions have become the threat for the continuity of supply chain operation (Peck and Juttner, 2002). The lack of concept in supply chain vulnerability means that a valid and reliable framework for the analysis needs to be tested in various environments. The concept must be applicable in many countries, industries and areas to see it universality. Svensson (2000) proposes

conceptual framework of supply chain vulnerability based on empirical analysis of 118 firms in retail, furniture and pre-manufactured industries. This study is limited to in-bound manufacturer logistics focusing on supplier performance in product delivery. Supply chain vulnerability is defined as the vast amount of existing variations of components and materials that the ultimate consumer may desire which at the same time is relying on a short interval of time for delivery. Svensson (2002) extends the research to include out-bound logistics in the analysis of supply chain vulnerability within automotive industry.

The survey indicates that supply chain vulnerability is the result of efforts to improve efficiency through the elimination of waste and redundancy. In spite of the extension of the study into out-bound logistics, the researcher acknowledges that the findings could not be generalized since the samples only come from single industry. Wagner and Bode (2006) perform empirical analysis on 760 firms in Germany to find the relationships between the drivers of supply chain vulnerability and supply chain risks. The results indicate that certain supply chain characteristics tend to exacerbate risks to put supply chain into a vulnerable position. The study has been focused on the drivers of supply chain vulnerability while the relationships between supply chain vulnerability and mitigation efforts have not been analyzed. As overall framework relationships of vulnerability mitigation strategy with its antecedents have not been explored in detail. Currently, the importance of

vulnerability mitigation in supply chains is increasing since logistic flows in many industries require efficient, effective and responsive (Christopher and Lee, 2004; Christopher and Peck, 2004). Unfortunately, supply chain development and its risk consequences in a package of supply chain mitigation strategy have not been fully examined.

**Supply chain vulnerability and mitigation strategy:**

Globalization creates unforeseen demand, supply source opportunity and intense competition because of fast product movements. Each firm has to consider the entry of foreign products as well as the advent of foreign competitors in their territories. The distance has streaming significantly and the flows of goods between countries have increased sharply. Supply chain has become more complex as a result of globalization and outsourcing activities (Choi and Krause, 2006; Blackhurst *et al.*, 2005; Ritchie and Brindley, 2004). In accordance, technology development has accelerated the speed of innovation to shorter product life cycle. Each firm has to deal with shorter trend as the new source of uncertainty in supply chain since the demand becomes more volatile. The global crisis started in the mid of 2007 has significant influence on the implementation of supply chain strategy. Many firms are struggling to face a down turn in demand volume, fluctuating commodity price including oil price and the pressure to reduce inventories. Aberdeen group survey reveals that from 2008-2009 the top cause of supply chain disruption was sharp reduction in customer demand (Fig. 3). This result is indeed different from survey from 2007-2008 that indicates supplier capacity was the main source of disruptions.

The ensuing global crisis has led to increase awareness of the importance in monitoring financial condition of the suppliers. Key supplier's financial standing has been deteriorated because of insufficient incomes and influent cash flow. The focus has been switched to mitigate the impact of higher forecasts, inventory surplus and customer order cancellation. The adoption of lean management turns into a requirement for worldwide manufacturers as the competition tension is increasing. However, a continued trend to leaning-down in supply chain development has also put supply chain network into a vulnerable position (Christopher and Rutherford, 2004; Chapman *et al.*, 2002; Svensson, 2004). Supply chain vulnerability is not only the result of environmental factors but the supply chain design itself has significant contribution (Juttner, 2005; Neureuther and Kenyon, 2009; Papadakis, 2006). The challenge is to manage and mitigate risk through balancing between efficiency and reliability. This study will reviewed whether

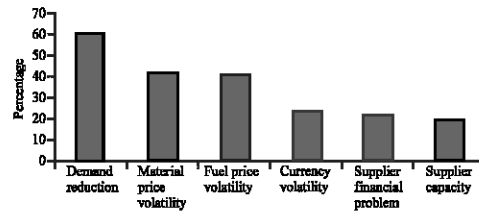


Fig. 3: Source of supply chain disruption 2008-2009

several vulnerability mitigation strategy concepts proposed by several researchers are still relevant to answer current Indonesia's environment. Vulnerability mitigation strategy should complement supply chain strategy to face turbulence markets in an effort to maintain business continuity. Interestingly, there is no study exploring supply chain vulnerability specifically within Indonesia context. Although, a survey performed by Vanany *et al.* (2007) has been intended to measure the impact of supply chain risks in Indonesian manufacturing, their study does not discuss the concept of supply chain vulnerability. Their study reveals that Indonesian managers have quiet limited scope on the implementation of risk management in supply chain due to various constraints including knowledge and organizational limitations. A firm should plan an appropriate mitigation strategy by exploring the source of risks, analyzing the drivers of supply chain vulnerability and measuring impact consequences. A mitigation strategy may reduce a tendency towards severe risk that may threat the survival of the firms. Norrman and Lindroth suggest a distinction be made between strategy to handle operational accidents and catastrophic uncertainty, based on probability and severity of the risk consequences. Juttner *et al.* (2003) define supply chain vulnerability as the propensity of risks to outweigh risk mitigation strategy causing supply chain disruption. Moreover, many firms lack an awareness of the need to consider the responsiveness as part of their overall approach to maintain business continuity (Hendricks and Singhal, 2003). Hence, vulnerability mitigation strategy must be developed intentionally to respond environmental changes. Researchers have proposed several required actions as mitigation strategy such as visibility (Christopher and Peck, 2004; Faisal *et al.*, 2006; Vanany *et al.*, 2007), flexibility (Chopra and Sodhi, 2004; Lee and Wolfe, 2003; Hendricks and Singhal, 2003), Supplier development (Thomas and Barton, 2007; Sheffi and Rice, 2005) and inventory control (Christopher and Peck, 2004; Christopher and Towill, 2001). However, vulnerability mitigation strategy should be able to balance between safety and responsiveness to deliver competitive advantage.

**Theoretical approach:** The objective of a firm's strategy is to achieve competitive advantage. The collaboration between firms has replaced single firm's strategy to gain a competitive position in the market place (Drucker, 1990; Lambert *et al.*, 1998). A firm may create competitive advantage either by reducing the cost of individual value chain or by reconfiguring overall value chain activities (Porter, 1985). A value chain is a sequence of activities where the products pass through the links within the chain to gain product value at each activity. The chain of activities gives the products more added value than the sum of added values of all activities. The goal of these chain activities is to provide the customer a level of value that exceeds the cost of the activities, thereby resulting in a profit margin. There are trade-offs between efficiency and reliability in the search for competitive advantage. Adopting lean management may improve the firm competitiveness. Nevertheless, a small disruption in the supply chain system could threaten the survival of the firms within the network. A firm must compensate certain degree of efficiency to maintain overall reliability. Supply chain vulnerability mitigation strategy should incorporate lean and effectiveness as well as risk mitigation measure. The most efficient supply chain system may not provide reliability. Contingency theory argues that the best strategy to manage the firm is non-existent. A strategy that fit in some situations may not appropriate in others (Fiedler, 1964). The optimal management style is contingent upon various internal and external environmental constraints. Reliability must be compensated through mitigation strategy although adds costs to maintain sustainable profit.

#### MATERIALS AND METHODS

Scholars have been very interested to understand the present of supply chain vulnerability. This study uses interviews to obtain information of supply chain vulnerability and mitigation strategy within Indonesian industry. Eight manufacturing firms from eight different sectors were randomly selected based on the list obtained from the industry classification of B2B PT Dataindo Inti Swakarsa (Table 2). Managers from selected manufacturing firms have been contacted to ask their agreement for the participations in the survey and select the appropriate time for the interviews. The selection of the managers is based on the purposive sampling method. The subjects are expected to have the expertise or information in related activities targeted by the researcher (Sekaran, 2003). The interviews were primarily conducted with managers dealing with supply chain activities such as supply chain managers, logistics managers, purchasing

Table 2. Respondent Interviewed Nr

Positions	Manufacturing sectors	Employees	Ownerships
Logistics manager	Apparel	850	Foreign owned
Quality assurance manager	Automotive	1420	Foreign owned
Supply chain manager	Fertilizer	2510	Local owned
Area and marketing manager	Food processing	29.245	Local owned
Supply chain manager	Pre-cast	910	Local owned
Purchasing manager	Shoes	150	Foreign owned
Purchasing manager	Electronic equipment	520	Foreign owned
Supply chain manager	Oil refinery	19.000	Local owned

managers or area managers. The samples chosen are ranging from low tech industries such as food, shoes and apparel into high tech industries such as automotive and electronic. The purpose of the interviews is not only to get the knowledge related to supply chain vulnerability but also to explore mitigation strategy implemented in their firms. A list of questions based on theoretical and literature approaches are prepared prior to the semi-structured interview. The samples are medium to large enterprise with at least 100 employees.

#### RESULTS AND DISCUSSION

**Supply chain vulnerability within Indonesia context:** The preliminary survey has been conducted between July and August 2009 to get the most relevant issue related to supply chain vulnerability within Indonesia context. The companies are located within Java (Jakarta, Banten and West Java provinces) and Sumatra islands. The number of employees in all of the surveyed companies is above 100 and their sales are above Rp. 100 billion a year. Interviews with managers related to supply chain activities reveal that the sources of supply chain disruptions could come from supply, demand, internal organization and environment. Most managers are unfamiliar with the concept of supply chain vulnerability. They consider that supply chain vulnerability means susceptible to experience disruptions. Supply chain vulnerability has been associated with high risk or high exposure within their organizations. Barnes and Oloruntoba (2005) define supply chain vulnerability as a susceptibility to loss because of existing condition due to organizational practices. While, Peck (2005) explains that supply chain vulnerability means supply chain is at risk, in which the loss or damage is likely to occur. The understanding of managers on supply chain vulnerability is still in line with definitions found in the literature.

Supply chain vulnerability refers to an increase of the risk level that may threaten the continuity of supply chain operation. Supply chain vulnerability is measured through the probability and the impact level of the risk (Sheffi and Rice, 2005). Managers indicate that there are

vulnerabilities in supply-side and demand-side. The vulnerability also increases because of efficiency efforts in their organizations.

They also realize environmental vulnerability such as flood, earthquake and big waves may disrupt material supply and product distribution although with less degree of severity. Furthermore, information distortion must be treated accordingly due to many speculation activities related to material and product price that may deviate forecast. The impact of globalization have significant contribution in creating complexity and dependence within supply chain activities in Indonesian manufacturing.

The reliance on global supply source is unavoidable. The development and the subsequent implementation of global supply source provide many advantages to Indonesian manufacturing. The benefits include amongst others improved product quality and greater product flexibility. All of the surveyed companies engage in global supply chain activities. The use of brokers in global supply source is a common practice since it is quiet difficult to manage procurement in foreign markets. In marketing the products, most of them are highly dependence on their foreign customers as the prime dealers to penetrate the market. These have created vulnerability in supply and demand because of lack of control and visibility. In addition, internally they also acknowledge that the implementation of lean management has exposed their supply chain network more vulnerable to risk. They realize the importance of mitigation strategy within supply chain to avoid severe disruptions. Mitigation actions have been purposively developed to avoid supply chain break-down. Production plants have been designed to allow flexible capacity if there is an increase or a decline in production volume. Sharing information and collaborative approaches are being implemented to improve visibility. Mutual commitment among supply chain members is very important to build understanding. Standard components and materials that could be easily found in the market have been used. They also try to control inventory by mapping material flows from the suppliers. Inventory threshold has been set up to deal with fluctuated production flows. To reduce dependence on global supply source and maintain quality, supplier development program has become the part of mitigation actions.

The results of the survey confirm that mitigation strategies in Indonesia environment should cover visibility, flexibility, supplier development and inventory control dimensions. However, some of vulnerability elements are beyond their managerial scopes. Most managers are unaware with supply chain vulnerability of

their global operations and do not consider too far if disasters happen to their foreign counterparts. Policies of their parent organizations or weak bargaining power are some of the dilemmas in the implementation of mitigation strategy.

Managers acknowledge that the implementation of mitigation strategy in line with supply chain development has brought some positive results.

## **CONCLUSION**

Preliminary survey in Indonesia reveals that managers related to supply chain activities are not familiar with the concept of supply chain vulnerability. However, they realize that their supply chain networks are exposed to higher risks as the results of globalization, leaning efforts and organizational constraint. In global activities, the dependence on their foreign suppliers and customers is high due to their limited organizational sizes and scopes.

The bargaining power is not strong enough to accomodate the needs of their firms in global activities. The complexity is increasing since they use brokers to get component supplies and rely on dealers to penetrate foreign markets. Larger samples are needed to get the real picture of supply chain vulnerability concept within Indonesian manufacturing companies.

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